

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/03839

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5872864 A	16-02-1999	JP 7099581 A	11-04-1995

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE
in its capacity as elected Office

Date of mailing (day/month/year) 29 May 2001 (29.05.01)	
International application No. PCT/GB00/03839	Applicant's or agent's file reference A25716 WO
International filing date (day/month/year) 05 October 2000 (05.10.00)	Priority date (day/month/year) 08 October 1999 (08.10.99)
Applicant PAWLESKI, Mark	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
10 April 2001 (10.04.01)

☐ in a notice effecting later election filed with the International Bureau on:

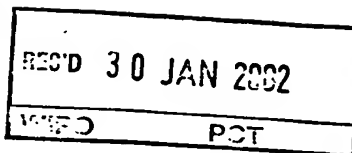
2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Zakaria EL KHODARY Telephone No.: (41-22) 338.83.38
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PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference A25716 WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB00/03839	International filing date (day/month/year) 05/10/2000	Priority date (day/month/year) 08/10/1999
International Patent Classification (IPC) or national classification and IPC G06K9/20		
Applicant BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 5 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 10/04/2001	Date of completion of this report 28.01.2002
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Zamuner, U Telephone No. +49 89 2399 7407 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/03839

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17):*)
Description, pages:

1-8 as originally filed

Claims, No.:

1-19 with telefax of 21/12/2001

Drawings, sheets:

1/10-10/10 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☒ the claims, Nos.: 20

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/03839

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	
	No: Claims	1-19
Inventive step (IS)	Yes: Claims	
	No: Claims	1-19
Industrial applicability (IA)	Yes: Claims	1-19
	No: Claims	

2. Citations and explanations
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/03839

- 1) Reference is made to the following document:

D1: US-A-5 872 864

Re Item V

- 2) Claim 1 do not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claim attempts, in step c), to define the subject-matter in terms of the result to be achieved which merely amounts to a statement of the underlying problem. The technical features necessary for achieving this result should be added.
- 3) The expression "*dark pixel data*" used in claims 1, 2, 3, 5 and 6 is vague and unclear and leaves the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of said claims unclear (Article 6 PCT).
- 4) The above clarity objections notwithstanding, the subject-matter of claim 1 is not new, and therefore does not meet the requirements of Art. 33(2) PCT, because all the features of claim 1 are known from D1. Indeed, claim 1 claims:
1. *a method for determining whether an image is a cartoon* (D1, col. 5 l. 13-21: the kind-of-image determining means use the output of the neural network to classify the image type, that can be, among the others, a graphic pattern image, i.e. also a cartoon, as stated in col. 1 l. 16-18; cartoons can consist also of very complex graphic patterns), *comprising*
 2. *(a) receiving values for respective picture elements of the image*; (D1, col. 4 l. 7-8)
 3. *(b) generating dark pixel data identifying picture elements of the image having a low luminance relative to other picture elements thereof*; (D1, col. 28 l. 24-65 and fig. 36C: when the apparatus of D1 receives in input a graphic pattern image, the modified luminance data generates dark pixel data, i.e. generates an histogram showing that the distribution of the luminance of the pixel is bimodal, dividing the

pixels between dark and light; see also col. 30 l. 5-9 and l. 28-53);

4. *(c) analysing only the dark pixel data to generate a signal indicating the likelihood that the image is a cartoon* (D1, col. 27 l. 11-14 and fig. 34: the kind of image is determined as a likelihood by the section 152; the dark pixel data are used as said in 4).3 above).
- 5) The subject-matter of dependent claims 2 to 8 is also not new, and therefore does not meet the requirements of Art. 33(2) PCT, because D1 discloses also all of the features that they add to the features of claim 1 (see D1, seventh embodiment, e.g. col. 26 l. 35 to col. 27 l. 28).
- 6) What has been said in point 2) and 3) for method claims 1 to 8 applies, *mutatis mutandis*, to apparatus claims 9 to 16.
- 7) The subject-matter of claim 17 does not involve an inventive step, and therefore does not meet the requirements of Art. 33(3) PCT, because claim 17 claims a data carrier for a computer program that, run on a computer, executes a method that has been found not new; the mere storage of a computer program as such on a data carrier is not inventive.
- 8) Claims 18 and 19 contain references to the drawings. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here (see also PCT Guidelines IV.III-4.10). Therefore these claims should be deleted.
- 9) The attention of the applicant is drawn to the fact that a reformulation of claim 1 to solve the clarity objections raised at point 2) and 3) above, and a combination of the features of a clarified claim 1 and claim 3 could possibly meet the criteria of novelty and inventive step.

CLAIMS

1. A method of determining whether an image is a cartoon, comprising
 - (a) receiving values for respective picture elements of the image;
 - 5 (b) generating dark pixel data identifying picture elements of the image having a low luminance relative to other picture elements thereof;
 - (c) analysing only the dark pixel data to generate a signal indicating the likelihood that the image is a cartoon.
- 10 2. A method according to claim 1 in which the step of generating the dark pixel data comprises dividing the image into blocks, and identifying those picture elements having, in accordance with a predetermined criterion, a lower luminance than the other elements within that block.
- 15 3. A method according to claim 2 in which the step of generating the dark pixel data includes assigning to a block a plurality of representative levels in accordance with the statistics of the values for the picture elements of the respective block, and identifying as lower luminance picture elements those elements whose values are nearest to the darkest one of the representative levels assigned to the block in which
20 it occurs.
4. A method according to claim 3 in which the step of assigning a plurality of representative levels comprises an iterative process of choosing that one of the representative levels in respect of which the standard deviation of the values of the
25 picture elements that are closest to it is largest, and replacing that level with two representative levels.

5. A method according to claim 1, 2, 3 or 4, in which the step of analysing the dark pixel data includes dividing the image into blocks and identifying those blocks which contain a relatively small number of pixels identified by the dark pixel data.

5 6. A method according to claim 5 when dependent on claim 2, 3 or 4 in which the same block division is used both for the generation of dark pixel data and for the analysis.

7. A method according to claim 5 or 6 in which the likelihood-representing
10 signal is obtained by counting the identified blocks.

8. A method according to claim 7 including the further step of comparing the likelihood-representing signal with a threshold to produce a signal to indicate that the image is or is not a cartoon.

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9. A apparatus for determining whether an image is a cartoon, comprising means (10) for receiving values for respective picture elements of the image and (50) generating dark pixel data identifying picture elements having a low luminance relative to other picture elements; and means (60) operable to analyse only the dark
20 pixel data to generate a signal indicating the likelihood that the image is a cartoon.

10. A apparatus according to claim 9 in which the means for generating the dark pixel data is operable (30) to divide the image into blocks, and (40, 50) to identify those picture elements having, in accordance with a predetermined criterion, a lower
25 luminance than the other elements within that block.

11. A apparatus according to claim 10 in which the means for generating the dark pixel data is operable (40) to assign to a block a plurality of representative levels in accordance with the statistics of the values for the picture elements of the

respective block, and (50) to identify as lower luminance picture elements those elements whose values are nearest to the darkest one of said representative levels.

12. A apparatus according to claim 11 in which the means for generating the dark pixel data is operable to assign the plurality of representative levels by an iterative process of choosing that one of the representative levels in respect of which the standard deviation of the values of the picture elements that are closest to it is largest, and replacing that level with two representative levels.

13. A apparatus according to claim 9, 10, 11 or 12, in which the means for analysing the dark pixel data is operable (62, 63) to identify those blocks of a plurality of blocks into which the image is divided which contain a relatively small number of pixels identified by the dark pixel data.

14. A apparatus according to claim 13 when dependent on claim 10, 11 or 12 in which the same block division is used both for the generation of dark pixel data and for the analysis.

15. A apparatus according to claim 13 or 14 in which the likelihood-representing signal is obtained (63) by counting the identified blocks.

16. A apparatus according to claim 15 including means (64) for comparing the likelihood-representing signal with a threshold to produce a signal to indicate that the image is or is not a cartoon.

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17. A data carrier loadable into a computer and carrying instructions for causing the computer to carry out the method according to any one of claims 1 to 8.

18. A method for classifying whether an image represents a cartoon substantially as described herein with reference to the accompanying drawings.

19. An apparatus for classifying whether an image represents a cartoon
5 substantially as described herein with reference to the accompanying drawings.

replaced by
Article 34

CLAIMS

1. A method for classifying whether an image represents a cartoon, comprising the step of generating a likelihood in dependence on the presence of low luminosity outlines in the image.
- 5 2. A method according to claim 1, and further comprising the steps of
analysing the image to provide one or more parameters wherein one parameter relates to the luminosity of the image; and
the generating step the generates the likelihood in dependence upon the value of
10 said one parameter.
3. A method according to claim 2, in which the image comprises a plurality of pixels and the analysing step includes the sub-step of vector quantising the image so that each pixel corresponds to one of a plurality of codes.
- 15 4. A method according to claim 3, in which the analysing step further comprises the sub-step of calculating the percentage of pixels corresponding to a one of the plurality of codes.
- 20 5. A method according to claim 4, in which said one of the plurality of codes is a code which corresponds to pixels of low luminosity.
6. A method according to any one of claims 3 to 5, in which the vector quantising sub-step comprises sub-steps of
25 dividing the image into a plurality of blocks, each block comprising a subset of pixels in the image; and
independently vector quantising each block.
7. A method according to claim 6, in which the generating step comprises the sub-
30 step of
generating a block likelihood value for each of a plurality of blocks, the block likelihood representing the probability that the pixels in that block represent an image comprising one or more outlines.

8. A method according to claim 7, in which the generating step further comprises the sub step of combining a plurality of block likelihood values to provide the likelihood value for the image.
- 5 9. An apparatus for classifying whether an image represents a cartoon, the apparatus comprising generating means for generating a likelihood in dependence on the presence of low luminosity outlines in the image.
- 10 10. An apparatus according to claim 9, and further comprising
means for analysing the image to provide one or more parameters wherein one parameter relates to the luminosity of the image; and
the generating means receives in operation said one parameter and generates the likelihood in dependence upon the value of said one parameter.
- 15 11. An apparatus according to claim 10, in which the analysing means comprises a vector quantiser which receives in operation a plurality of pixels comprising the image and outputs a plurality of codes each output code corresponding to each of the received pixels.
- 20 12. An apparatus according to claim 11, in which the analysing means further comprises means for calculating the percentage of pixels corresponding to a one of the plurality of codes.
13. An apparatus according to claim 12, in which said one of the plurality of codes is
25 a code which corresponds to pixels of low luminosity.
14. An apparatus according to any one of claims 11 to 13, in which the vector quantiser further comprises
means for dividing the image into a plurality of blocks, each block comprising a
30 subset of pixels in the image; and
means for independently vector quantising each block.
15. An apparatus according to claim 14, in which the generating means comprises

means for generating a block likelihood value for each of a plurality of blocks, the block likelihood representing the probability that the pixels in that block represent an image comprising one or more outlines.

5 16. An apparatus according to claim 15, in which the generating means further comprises means for combining a plurality of block likelihood values to provide a likelihood value for the image.

10 17. A data carrier loadable into a computer and carrying instructions for causing the computer to carry out the method according to any one of claims 1 to 8.

18. A data carrier loadable into a computer and carrying instructions for enabling the computer to provide the apparatus according to any one of claims 9 to 16.

15 19. A method for classifying whether an image represents a cartoon substantially as described herein with reference to the accompanying drawings.

20. An apparatus for classifying whether an image represents a cartoon substantially as described herein with reference to the accompanying drawings.

(19) World Intellectual Property Organization
International Bureau



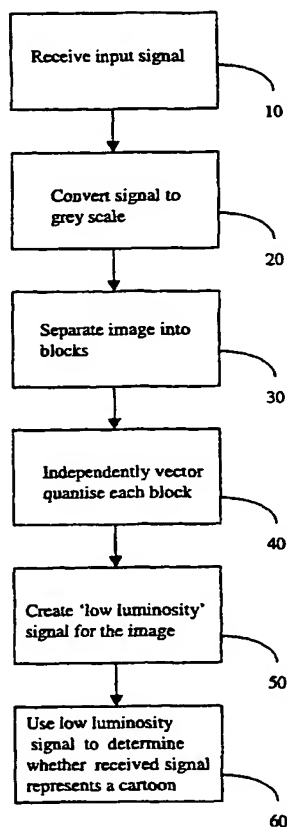
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99307971.4 8 October 1999 (08.10.1999) EP
- (71) Applicant (for all designated States except US): **BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY** [GB/GB]; 81 Newgate Street, London EC1A 7AJ (GB).
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- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **CARTOON RECOGNITION**



(57) Abstract: A method of analysing an image for example from a video signal for the presence of outlines to determine whether the image is likely to represent a cartoon is based on the concept that cartoons are often characterised by the presence of dark outlines around objects. In an improved version the signal is separated into signals representing smaller areas of the image before analysing each signal for the presence of dark outlines.

WO 01/27865 A1

Cartoon Recognition

This invention relates to a method of and apparatus for determining whether an image, for example a frame of a video signal, represents a cartoon.

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With the growing availability of online data, provision of hundreds or even thousands of data channels by an information provider causes problems of content management and verification, as manual checking of every piece of data becomes infeasible. For image data, there is increasing interest in techniques for automated image interpretation and classification. Automated image interpretation and classification could help with indexing, cataloging and searching of still image or moving image databases.

Image interpretation and classification can be done either by the service provider or by the service receiver. For example, if it is possible to determine whether a signal represents a cartoon or not then it is possible for parents to stop children from downloading pictures from the Internet or from watching TV programs other than cartoons. Other types of classifiers could prove useful, for example, classification of pornographic images or recognition of particular people.

20 According to the present invention there is provided a method for classifying whether an image represents a cartoon, comprising the step of generating a likelihood in dependence on the presence of low luminosity outlines in the image.

According to the present invention there is also provided a data carrier loadable into a computer and carrying instructions for causing the computer to carry out said method.

In a preferred embodiment the method further comprises the step of analysing the image to provide one or more parameters wherein one parameter relates to the luminosity of the image; and the generating step determines the generated likelihood in dependence upon the value of said one parameter.

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Advantageously the image comprises a plurality of pixels and the analysing step includes the sub-step of vector quantising the image so that each pixel corresponds to one of a plurality of codes.

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Preferably the analysing step further comprises the sub-step of calculating the percentage of pixels corresponding to a one of the plurality of codes and preferably said one of the plurality of codes is a code which corresponds to pixels of low luminosity.

- 5 In a preferred embodiment the vector quantising sub-step comprises sub-steps of dividing the image into a plurality of blocks, each block comprising a subset of pixels in the image; and independently vector quantising each block.

- Advantageously the generating step comprises the sub-step of generating a block
10 likelihood value for each of a plurality of blocks, the block likelihood representing the probability that the pixels in that block represent an image comprising one or more outlines and preferably the generating step comprises the sub-step of combining a plurality of block likelihood values to provide the likelihood value for the image.

- 15 According to another aspect of the present invention there is provided apparatus for classifying whether an image represents a cartoon said apparatus comprising generating means for generating a likelihood in dependence on the presence of low luminosity outlines in the image.

- 20 According to the present invention there is also provided a data carrier loadable into a computer and carrying instructions for enabling the computer to provide said apparatus.

- In a preferred embodiment the apparatus further comprises means for analysing the image to provide one or more parameters wherein one parameter relates to the luminosity
25 of the image; and the generating means receives in operation said one parameter and determines the generated likelihood in dependence upon the value of said one parameter.

- Advantageously the analysing means comprises a vector quantiser which receives in operation a plurality of pixels comprising the image and outputs a plurality of codes each
30 output code corresponding to each of the received pixels.

Preferably the analysing means further comprises means for calculating the percentage of pixels corresponding to a one of the plurality of codes and said one of the plurality of codes is a code which corresponds to pixels of low luminosity.

In a preferred embodiment the vector quantiser further comprises means for dividing the image into a plurality of blocks, each block comprising a subset of pixels in the image; and means for independently vector quantising each block.

- 5 Advantageously the generating means comprises means for generating a block likelihood value for each of a plurality of blocks, the block likelihood value representing the probability that the pixels in that block represent an image comprising one or more outlines and the generating means further comprises means for combining a plurality of block likelihood values to provide a likelihood value for the image.

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An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which

- Figure 1 is a schematic representation of a computer loaded with software embodying the present invention;

Figure 2 shows red, blue, green and luminance components for a cartoon;

Figure 3 shows red, blue, green and luminance components for a photograph;

Figure 4 shows red, blue, green and luminance components for a complex cartoon;

- Figure 5 is a functional block diagram of the program elements that comprise the software indicated in Figure 1;

Figure 6 is a flow chart showing the method steps performed in one embodiment of the invention by the software illustrated in Figure 5;

Figure 7 is a flow chart showing the vector quantising step of the method illustrated in Figure 6;

- Figure 8 is a flow chart showing the production of a low luminosity signal;

Figure 9 shows images for each level of vector quantisation for a cartoon and a photograph; and

Figure 10 is a flow chart showing the determination step of the method illustrated in Figure 6.

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- Figure 1 illustrates a conventional computer 101, such as a Personal Computer, generally referred to as a PC, running a conventional operating system 103, such as Windows (a Registered Trade Mark of Microsoft Corporation), and having a number of resident application programs 105 such as a word processing program, a network browser and e-mail program or a database management program. The computer 101 also includes an

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image classification program 109 that enables a signal representing an image to be classified according to whether the image represents a cartoon. The computer 101 is also connected to a conventional disc storage unit 111 for storing data and programs, a keyboard 113 and mouse 115 for allowing user input and a printer 117 and display unit 119 for providing output from the computer 101. The computer 101 also has access to external networks (not shown) via a network card 121.

A simple image classification program for determining whether an image represents a cartoon can be implemented which analyses the colour distribution within the image. Figure 2a shows a cartoon (represented in a grey scale in the figure). Figure 2b is a histogram showing the number of pixels with particular values for the red component. Figures 2c, 2d and 2e show similar histograms for the green, blue and luminance components. For this cartoon there are prominent spikes in each component. Figure 3 shows a similar set of histograms for an image which is not a cartoon. The distribution for each component shows no such spikes. However, for a more complicated cartoon, such as that shown in Figure 4, it is difficult to see any obvious distinction between the histograms of Figures 4b - 4e and those of Figures 3b - 3e.

As shown in Figure 6, in accordance with a method of the present invention at step 10 an input signal representing an image, for example a frame of video data, comprising a plurality of pixels is received. At step 20 the received signal is converted into a luminosity signal, which represents a grey scale version of the image, by calculating a luminosity value (L) for each pixel. The received signal has components representing a value in the range 0 to 255 for a red component (R) a blue component (B) and a green component (G) for each of the plurality of pixels which comprise the frame of video data. The luminosity value is calculated at step 20 using the equation

$$L = 0.299R + 0.587G + 0.114B$$

It is not necessary to use a calculated luminosity value; the invention works equally well if a vector comprising, for example, the R, G and B values is used. At step 30 the image represented by the luminosity signal is split into a plurality of block signals, each signal representing an area of the original image. In the embodiment of the invention described here, each block signal represents an area of the same size as the area represented by each other block signal (although the size may differ slightly due to quantisation effects). However, the areas represented by the block signals could equally well be different sizes from each other.

At step 40 each block signal is vector quantised into a predetermined number of levels. A code (for example an integer in the range 1 to the predetermined number of levels) being used to represent each level. At step 50 the vector quantised signals are used to provide
5 a low luminosity signal comprising the vector quantised signals which represent the darkest level for each block. Finally at step 60 the lowest luminosity signal is used to determine whether the received signal represents a cartoon. It is not necessary to split the luminosity signal into a plurality of block signals prior to vector quantisation. However, the determination at step 60 is more accurate if the received signal is split into signals
10 representing smaller blocks of the frame.

The algorithm now described with reference to Figure 7 is used to determine the level represented by each code and to assign each pixel value to a code. It is similar to the well known LBG algorithm (as described in Linde, Y, Buzo, A and Gray, R. M. "An algorithm for
15 vector quantizer design", IEEE Trans. Comm., vol. COM-28, Jan 1980, S 84-86). In Figure 7 at step 42 each pixel value is assigned to a code. Initially there is a single code used to represent each pixel value. At step 43, for the or each code, the mean and the standard deviation of the pixel values which the or each code currently represents are calculated. The mean for the or each code is then associated with that code. At step 44, the code
20 which represents pixel values having the greatest standard deviation is determined. A new value to be associated with that code is then calculated at step 45 as the mean for that code minus half the standard deviation for that code. If the new value is calculated to be less than zero then the new value is set to zero. At step 46 a new value to be associated with a new code is calculated as the mean plus half said standard deviation.

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At step 47 one of the plurality of codes is assigned to each pixel value. A code is used to represent a pixel value if the value which that code is associated with is 'closer' to the pixel value than any of the other codes. In this embodiment of the invention, a luminosity value is used, so it is a simple matter to measure the distance between the luminosity
30 value and the value associated with a code, by calculating the difference between the two values. In embodiments which use a vector of values to represent each pixel, such as R, G, and B values, a distance may be calculated using, for example, the 'city-block' distance or the least squares distance.

35 At step 48 a check is performed to check whether the number of codes corresponding to

the predetermined number of levels have been created. If not, the steps 43 to 47 are repeated. In the embodiment of the invention described here four codes are created for each block, although the number of codes (and hence the predetermined number of levels) does not need to be the same for each block. In embodiments of the invention
5 using a vector of values for each pixel the vector quantising step operates in an analogous manner to that described above.

In Figure 8 at step 51 each block is taken in turn. At step 52 the luminance value for each pixel is set to be equal to the value associated with the code which is used to represent
10 that pixel. At step 53 a signal is generated with the luminance value for each pixel set to white for each pixel which is not represented by the code associated with the lowest luminosity value for that block. In the embodiment of the invention described here a similar signal is generated (for display purposes) for each one of the codes, in order to generate images for each vector quantisation level. The image generated from the signals for the
15 lowest luminosity value will be referred to as a level 0 image, the image generated from the signals for the next highest luminosity value will be referred to as a level 1 image, etc.

Figure 9 shows cartoon image 71 and photographic image 81, together with level 0 images 72 and 82, level 1 images 73, and 83, level 2 images 74 and 84, and level 3
20 images 75 and 85. It can be seen that the level 0 image 72 generated from the lowest luminosity signal for each block for the cartoon image 71 differs from the corresponding level 0 image 82 generated from a signal representing the photographic image 81. The level 0 image 72 clearly comprises a plurality of outlines whereas the level 0 image 82 does not. This is because even complex cartoons have outlines delineating the areas of
25 one colour from the areas of another colour, even when the areas of colour are carefully shaded. Photographic images do not have such outlines. Small areas of the level 0 image 82 may be mistakenly judged to contain outlines, however the majority of the image 82 does not contain outlines.

30 At step 61 of Figure 10 the signal representing a frame of video data is separated into block signals representing smaller areas of the frame. These need not be the same size areas as were produced at step 30 of Figure 6. Again, each area represented by a signal need not necessarily be the same size as each other area represented by a signal. At step 62 the number of dark pixels for each block is determined. Then at step 63 the
35 number of blocks which are likely to contain outlines is determined by testing whether the

percentage of dark pixels in a block less than a predetermined dark-threshold. At step 64 a test is performed as to whether the number of blocks which are likely to contain outlines divided by the total number of blocks is greater than a predetermined outline-threshold. If the calculated ratio is greater than the outline-threshold then the signal is deemed to represent a cartoon, otherwise the signal is deemed not to represent a cartoon. In the embodiment described, the test for whether a block contains outlines is fairly simple. It would be possible to replace steps 62 and 63 by a more sophisticated algorithm which detects, for example, narrow bands of dark pixels, or an algorithm for detecting substantially parallel edges where pixels change from dark to light, or vice versa, or to implement a classifier using a neural network.

As shown in Figure 5 an image classification program 109 according to the invention comprises a grey scale converter 130 which performs steps 10 and 20 of Figure 6, an analysing means 140 which performs steps 30, 40 and 50 of Figure 6, and a likelihood generator 150 which performs step 60 of Figure 6. The analysing means 140 comprises a vector quantiser 142 which performs steps 30 and 40 of Figure 6 and a luminosity parameter generator 144 which performs step 50 of Figure 6. The likelihood generator 150 comprises a low luminosity block signal generator 152, a block likelihood generator 154 and a likelihood combiner 156. The vector quantiser 142 comprises a block signal generator 146 and a block signal vector quantiser 148. The luminosity parameter generator 144 comprises a low luminosity signal generator 132 and a percentage of low luminosity signals calculator 134.

As will be understood by those skilled in the art, the image classification program 109 can be contained on various transmission and/or storage mediums such as a floppy disc, CD-ROM, or magnetic tape so that the program can be loaded onto one or more general purpose computers or could be downloaded over a computer network using a suitable transmission medium.

Whilst the invention has been described with reference to a signal representing an image comprising a plurality of pixels, it will be appreciated that the detection of low luminosity outlines may equally well be performed on images for which the original source of the image does not represent the image as a plurality of pixels.

Unless the context clearly requires otherwise, throughout the description and the claims, the words "comprise", "comprising" and the like are to be construed in an inclusive as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to".

CLAIMS

1. A method for classifying whether an image represents a cartoon, comprising the step of generating a likelihood in dependence on the presence of low luminosity outlines in the image.
- 5 2. A method according to claim 1, and further comprising the steps of analysing the image to provide one or more parameters wherein one parameter relates to the luminosity of the image; and the generating step the generates the likelihood in dependence upon the value of
10 said one parameter.
3. A method according to claim 2, in which the image comprises a plurality of pixels and the analysing step includes the sub-step of vector quantising the image so that each pixel corresponds to one of a plurality of codes.
- 15 4. A method according to claim 3, in which the analysing step further comprises the sub-step of calculating the percentage of pixels corresponding to a one of the plurality of codes.
- 20 5. A method according to claim 4, in which said one of the plurality of codes is a code which corresponds to pixels of low luminosity.
6. A method according to any one of claims 3 to 5, in which the vector quantising sub-step comprises sub-steps of
25 dividing the image into a plurality of blocks, each block comprising a subset of pixels in the image; and independently vector quantising each block.
7. A method according to claim 6, in which the generating step comprises the sub-
30 step of generating a block likelihood value for each of a plurality of blocks, the block likelihood representing the probability that the pixels in that block represent an image comprising one or more outlines.

8. A method according to claim 7, in which the generating step further comprises the sub step of combining a plurality of block likelihood values to provide the likelihood value for the image.
- 5 9. An apparatus for classifying whether an image represents a cartoon, the apparatus comprising generating means for generating a likelihood in dependence on the presence of low luminosity outlines in the image.
- 10 10. An apparatus according to claim 9, and further comprising
means for analysing the image to provide one or more parameters wherein one parameter relates to the luminosity of the image; and
the generating means receives in operation said one parameter and generates the likelihood in dependence upon the value of said one parameter.
- 15 11. An apparatus according to claim 10, in which the analysing means comprises a vector quantiser which receives in operation a plurality of pixels comprising the image and outputs a plurality of codes each output code corresponding to each of the received pixels.
- 20 12. An apparatus according to claim 11, in which the analysing means further comprises means for calculating the percentage of pixels corresponding to a one of the plurality of codes.
13. An apparatus according to claim 12, in which said one of the plurality of codes is
25 a code which corresponds to pixels of low luminosity.
14. An apparatus according to any one of claims 11 to 13, in which the vector quantiser further comprises
means for dividing the image into a plurality of blocks, each block comprising a
30 subset of pixels in the image; and
means for independently vector quantising each block.
15. An apparatus according to claim 14, in which the generating means comprises

means for generating a block likelihood value for each of a plurality of blocks, the block likelihood representing the probability that the pixels in that block represent an image comprising one or more outlines.

5 16. An apparatus according to claim 15, in which the generating means further comprises means for combining a plurality of block likelihood values to provide a likelihood value for the image.

10 17. A data carrier loadable into a computer and carrying instructions for causing the computer to carry out the method according to any one of claims 1 to 8.

18. A data carrier loadable into a computer and carrying instructions for enabling the computer to provide the apparatus according to any one of claims 9 to 16.

15 19. A method for classifying whether an image represents a cartoon substantially as described herein with reference to the accompanying drawings.

20. An apparatus for classifying whether an image represents a cartoon substantially as described herein with reference to the accompanying drawings.

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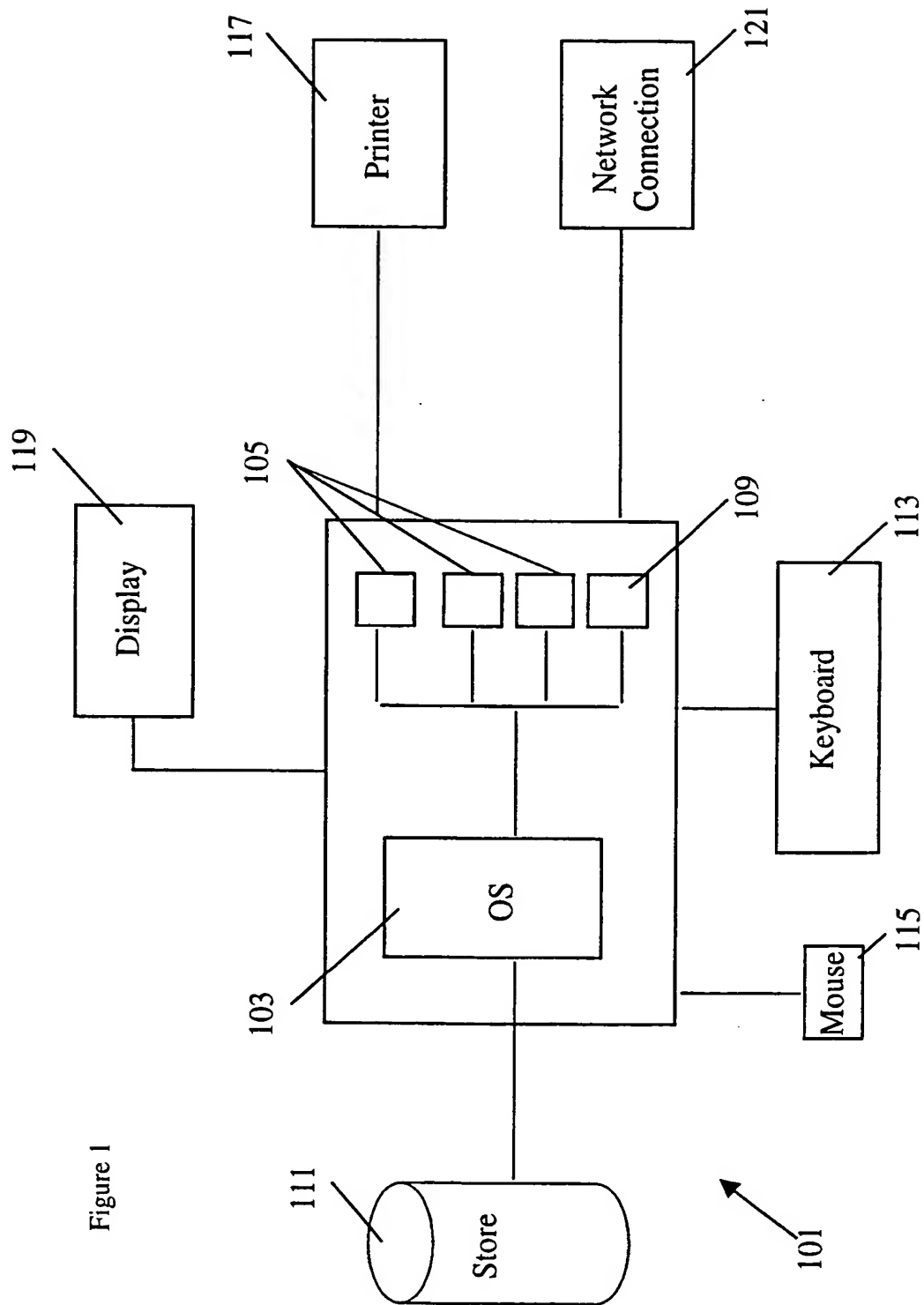


Figure 1

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Figure 2a

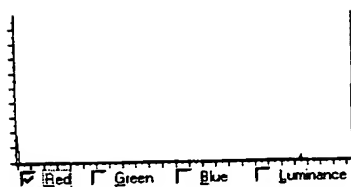


Figure 2b

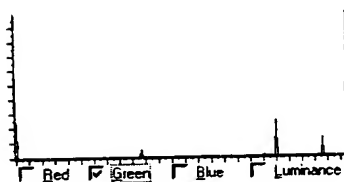


Figure 2c

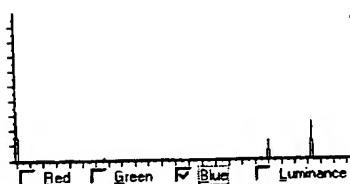


Figure 2d

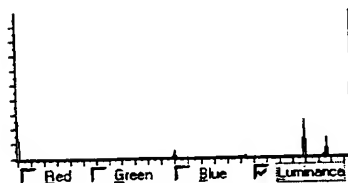


Figure 2e

Figure 2

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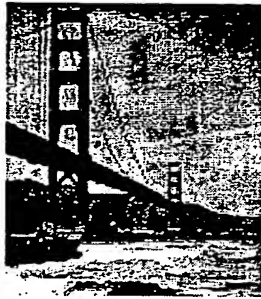


Figure 3a

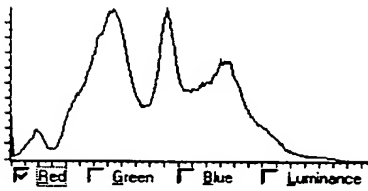


Figure 3b



Figure 3c

Figure 3

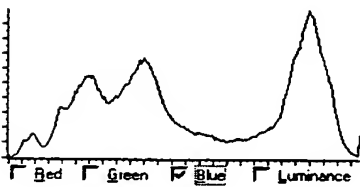


Figure 3d

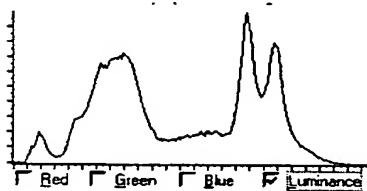


Figure 3e

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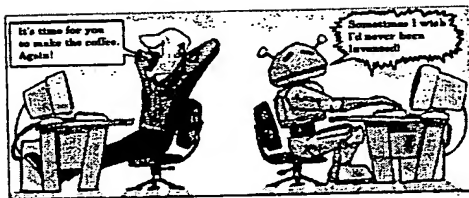


Figure 4a

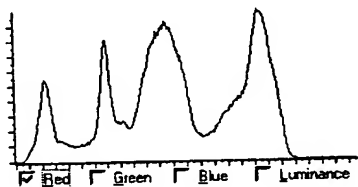


Figure 4b

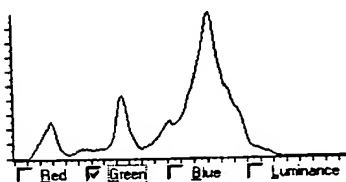


Figure 4c

Figure 4

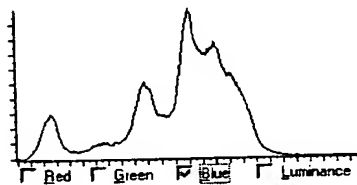


Figure 4d

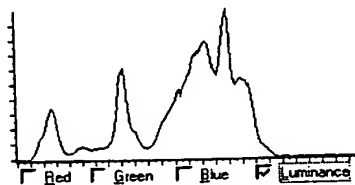


Figure 4e

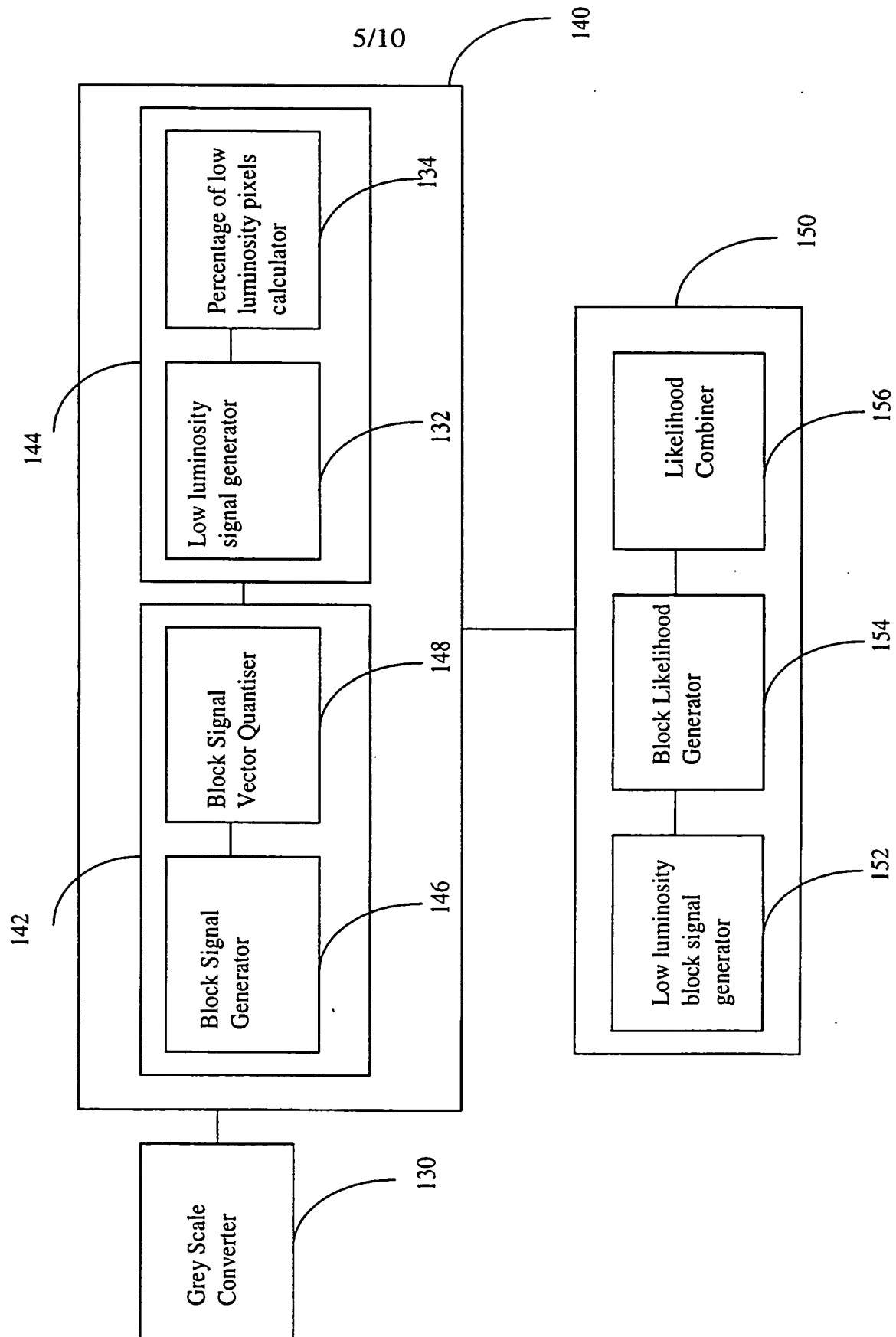
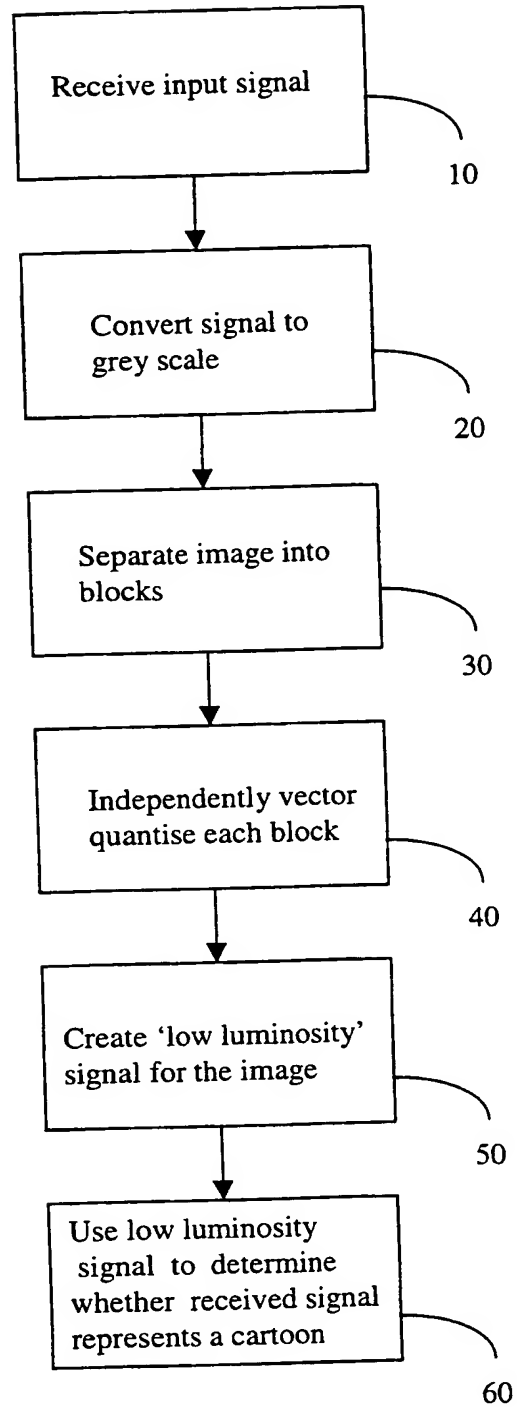


Figure 5

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Figure 6



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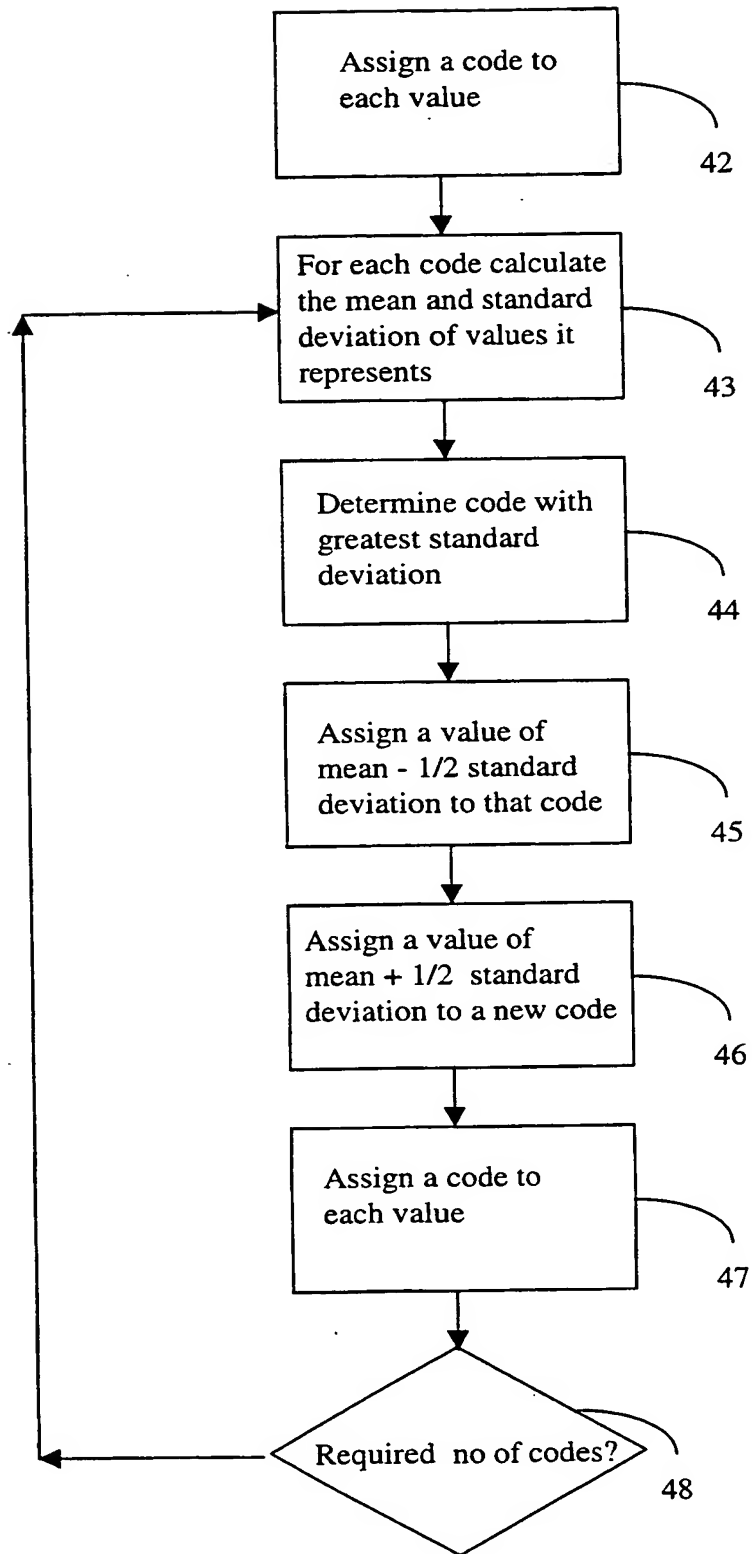


Figure 7

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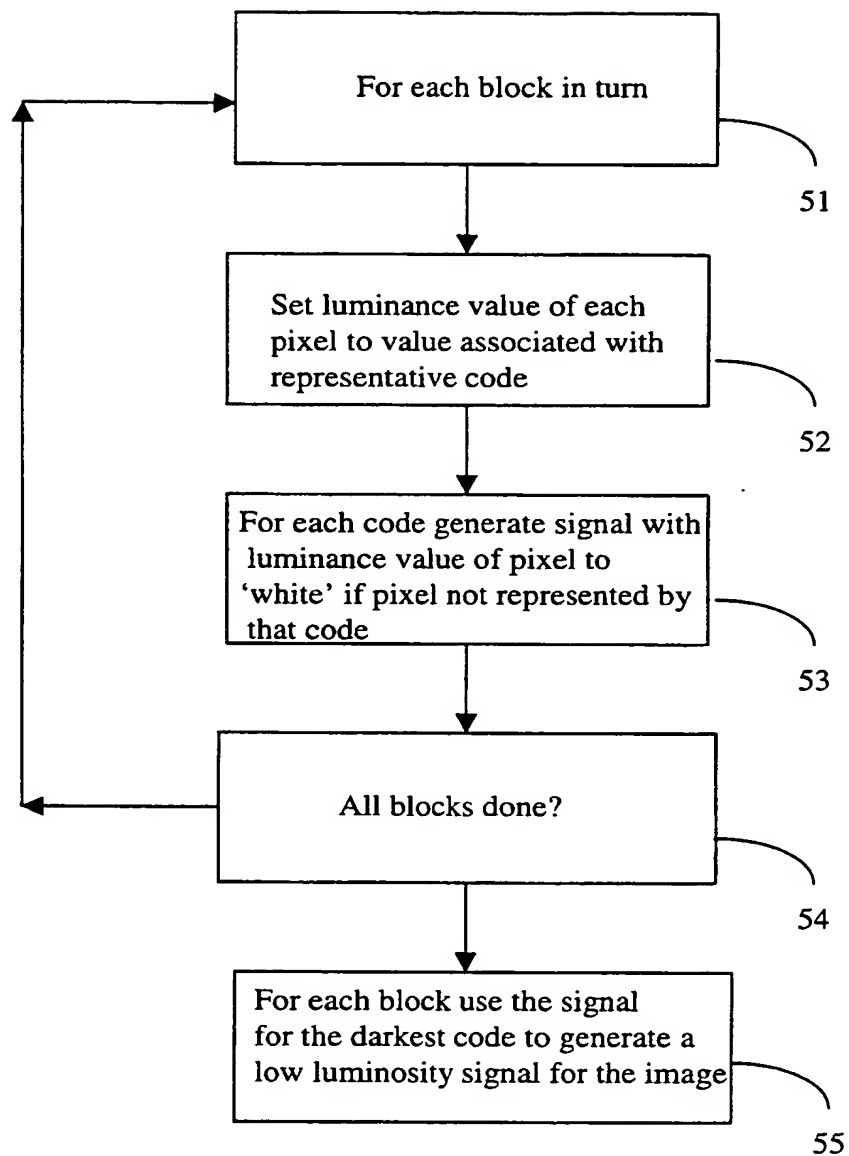
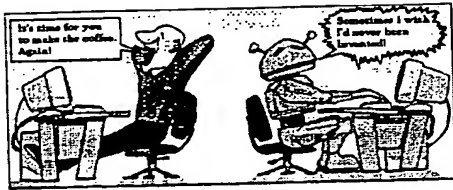


Figure 8

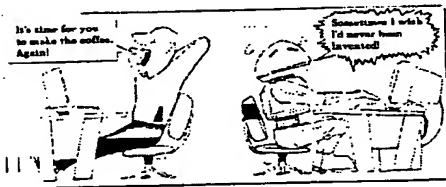
9/10



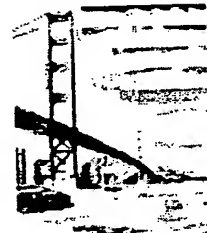
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81



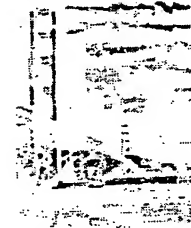
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82



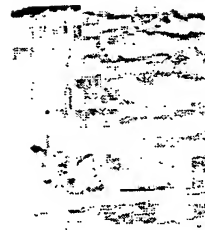
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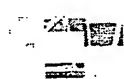
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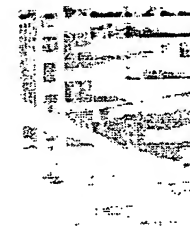
74



84



75



85

Figure 9

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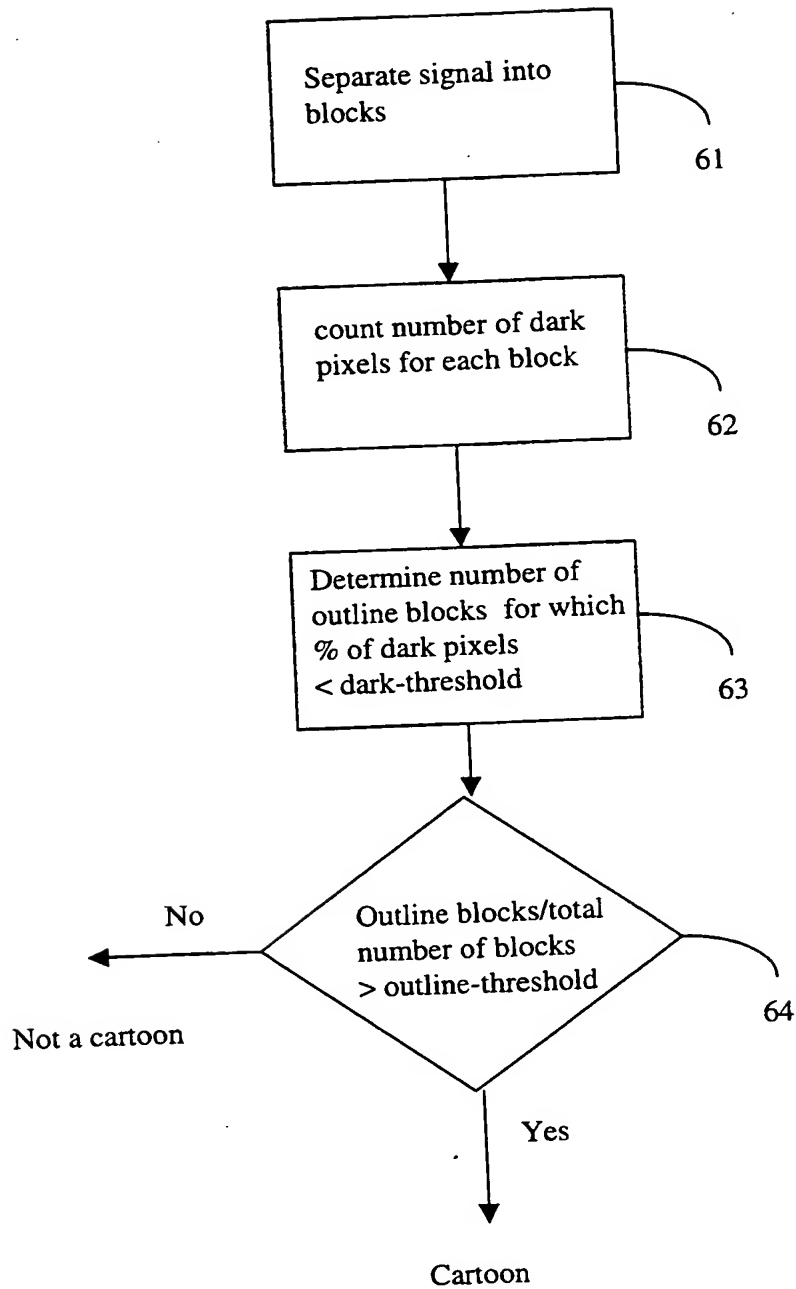


Figure 10

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference A25716 WO	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 00/ 03839	International filing date (day/month/year) 05/10/2000	(Earliest) Priority Date (day/month/year) 08/10/1999
Applicant BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.
☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

6

☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

PC/GB 00/03839

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06K9/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC, WPI Data, IBM-TDB, PAJ, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 872 864 A (TATSUTA SEIJI ET AL) 16 February 1999 (1999-02-16) column 4, line 49 - column 5, line 21 column 5, line 54 - line 65 column 26, line 24 - column 31, line 18; figures 34,36 -----	1-20



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

7 November 2000

Date of mailing of the international search report

14/11/2000

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Authorized officer

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